TRAINING SUGAR TECHNOLOGISTS FOR THE TWENTY-FIRST CENTURY

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Abstract

Training of sugar technologists for the South African industry began in 1928 and developed into a three-year diploma or two-year certificate course offered by the Sugar Milling Research Institute (SMRI) in conjunction with local technikons. These courses served the industry well but needed change when, approximately fifteen years ago, it was perceived that good candidates objected to training which tended to restrict them to working in a single industry. A rational change was to terminate the sugar diploma courses and to recruit candidates after they had completed general engineering training. To give these graduates and diplomates a grounding in sugar technology, a three-week course in sugar technology was established. This was subsequently replaced by an intensive ten-week course also for graduates and diplomates to be held every eighteen months. Concurrent with these events, the SMRI training officer was seconded to the South African Sugar Association Industrial Training Centre (ITC) to teach sugar manufacture and laboratory worker courses to operators and process supervisors. These courses have recently been extensively restructured to meet new criteria and to keep abreast of the needs of the sugar industry. Details of these, and other courses, which include a one-week introductory course in sugar technology and a two-day course in sugar technology which is devised for industry personnel not directly involved in sugar manufacture (e.g. administration, agricultural and engineering maintenance staff), are given. Lectures in sugar technology for the Department of Applied Chemistry at the University of Natal are also considered.

Introduction

The expressions 'education' and 'training', which are often regarded as synonymous are, in fact, quite different. Education develops students intellectually and provides a basis for further learning. As such it has little application to a specific job. In contrast, training is concerned with teaching a specific skill to enable the learner to perform a task effectively and to achieve the goals of the organisation soon after the completion of the training.

"The most important aspect of training and development is that it is a means of making employees more valuable to the organisation by extending their skills and knowledge, modifying their attitudes to the job and adjusting their patterns of behaviour in the organisation." (Gerber *et al.*, 1987). Business sees the reasons for training as leading to:

- more effective and efficient staff who require less supervision
- lower operational costs
- reduced wastage
- increased competitiveness by improving product quality and quantity
- fewer accidents.

From a human resources perspective the reasons for training are:

- fostering the right attitudes (i.e. increased motivation, commitment and loyalty)
- improved job performance
- improved staff confidence and morale
- enhanced individual job security
- more internal candidates for promotion.

Training is therefore very important, as there are pressing needs facing the sugar industry:

Productivity. This is especially important in terms of deregulation of the local industry and increasing international competition from countries with lower labour and hence, lower production, costs.

Labour relations. Employees need to be aware of the 'bigger picture' and the importance of their role in the organisation. Knowledge and understanding have a definite impact on perceptions and management-employee relationships. Despite the cultural diversity of the work force an integrated, efficient and motivated work team needs to be created.

Job satisfaction and commitment. Knowledge and competence empower an employee and allow him/her to take charge of his/her own career development.

Affirmative action. In the process of ensuring that all levels of the work force are representative of society, factories could be hampered in the short term by a deficiency in personnel with the specific skills required by the industry. An aggressive training programme is the only route that will satisfy the needs of the industry.

Maintenance of competence. The skills of employees do not remain constant. They deteriorate and can become obsolete due to technological developments and improvements.

Effective training needs to have two components, *ad hoc* or 'on-the-job' instruction and intensive, formal tuition.

The past

For 70 years the South African sugar industry has been aware of the importance of training its technical staff. The first course was established in 1928 by the South African Sugar Association and was conducted for part-time students at the Natal Technical College during the industry's off season. A Final Certificate was issued by the South African Sugar Technologists' Association (SASTA) and, in addition, students could write the London City and Guilds Institute examination in Sugar Manufacture (Matic and Wiehe, 1969). The years of the depression and World War II interrupted this course and it was terminated in 1957 when the London City and Guilds Institute stopped conducting the examinations. Meanwhile, Dowes-Dekker (1956), having received requests for information on courses in sugar technology, and realising that there was a serious shortage of suitably qualified sugar technologists, agreed that training in sugar technology was most desirable. Hence a Diploma in Sugar Technology was implemented at the Natal Technikon in 1964 under the auspices of the Natal Sugar Millers' Association [the predecessor of the South African Sugar Millers' Association Limited (SASMAL)] and the SMRI. At the start of 1978 a two-year certificate course was introduced at the ML Sultan Technikon and in January 1981 it was also established at Mangosuthu Technikon. In 1981 a paper was presented at the fifty-fifth Annual Congress of SASTA giving a seventeen-year review of the Training Division of the SMRI (Wiehe, 1981). Two years after this review it was decided to terminate the Diploma Course and to draw future process personnel from those who held the Diploma in Chemical Engineering, a course which had been introduced by local technikons some five years previously (Pillay, 1985). Three reasons were given for this move:

- The sugar technology course was too specialised
- The course was not viable due to insufficient demand
- The status of processing staff was believed to be lower than that of the engineering department due to the fact that engineers were usually university graduates.

A knowledge of sugar technology was necessary to prepare these chemical engineers to fulfil their roles in the sugar factories, and the SMRI was called upon to provide the necessary training. A three-week Intensive Course in Sugar Technology, held annually, was inaugurated and, although the course was successful, sugar companies requested that they be extended and that provision be made to include mechanical and electrical engineers.

From 1978 to 1982, the SMRI was also involved in lecturing to second year Applied Chemistry students at the University of Natal, Durban. A six credit course, part of the 'Introduction to Chemical Process Technology', was seen as an initiation to the chemical industry and included the topic 'Sugar Manufacture' to illustrate the application of basic principles in chemical processing, process technology and factory control. During the following decade the course was redesigned and became part of the subject 'Intermediate Applied Chemistry – Industrial'. Given to second year students, it consisted of eight lectures. No lectures were given during 1994-1995.

The present

The SMRI now offers several courses, each aimed at satisfying a particular need.

Ten-Week Course

The first Ten-Week Course in Sugar Engineering was held at the SMRI in 1993 and was attended by candidates from South Africa and the neighbouring countries. Table 1 shows the increasing demand for this course which is held at intervals of 18 months. This course is aimed at graduates and diplomates in the factory who are specialising in production. Candidates are drawn from South African and affiliated member mills, with a limited number of places available to delegates from foreign non-member mills. The syllabus is listed in Table 2.

Table 1. Ten-Week Course attendance.

Year	Number of candidates
February to April 1993	11
September to November 1994	17
February to April 1996	16
September to November 1997	25

Table 2. Syllabus for the Ten-Week Course.

Sugar machinery
Sugar technology
Factory performance calculations
Process control
Sugar cane agriculture
Plant visits
Special projects involving literature search and report writing
Engineering maintenance *or* Laboratory practice

Notable features of this course are:

- rigorous coverage of subjects, with emphasis on standards
- a judicious mixture of in-depth theoretical training and practical experiential learning
- the lecturers are drawn from the SMRI staff as well as other specialists in the sugar industry
- students have the option of specialising in either laboratory practice or engineering maintenance
- regular examinations are given as each section is completed
- certificates, detailing the subjects taken, are awarded to successful students.

One-Week Course

This sugar technology course is held annually at a Durban hotel and is directed towards graduates and diplomates in the engineering departments of sugar factories/ refineries. It is of a general nature and is intended as an introduction to the manufacturing process. All the basic factory processes are

covered, but to a limited depth. The course includes visits to the South African Sugar Terminals, a refinery and a heavy engineering works. As with the ten-week course, testing takes place throughout and successful candidates are awarded certificates. The numbers of candidates attending this course since its inception are listed in Table 3.

Table 3. One-Week Course attendance.

Year	Number of candidates
1993	20
1994	22
1995	31
1996	30
1997	35

Two-Day Course

This is aimed at staff who are not directly involved in the sugar manufacturing process, but are in supportive positions such as maintenance, stores, agriculture and clerical and secretarial roles. These courses are offered on request and are held at a factory. The course was first presented in 1988 and has subsequently been presented approximately three times per year.

University of Natal

A six lecture course entitled 'Introduction to Sugar Technology' is given to third year Applied Chemistry students. The basic unit operations employed in the production of raw and white sugars, with particular emphasis on the chemical reactions in the process, are illustrated. As with the previous courses, visits to factories are included and examinations are set.

South African Sugar Association Industrial Training Centre

This organisation was established in 1974 for the purpose of training apprentices and artisans. In 1978 Sugar Process training was established. The ITC courses in sugar manufacture and laboratory practice are designed for factory operators and candidate supervisors who need to obtain a deeper understanding of the principles and mechanisms that form part of the factory process. As from 1989 the Training Officer at the SMRI was co-opted by the ITC for six months of the year to manage the Laboratory Practice and Sugar Manufacture modules. When this Officer resigned at the end of 1994, the senior staff of the Analytical Services Division of the SMRI 'held the fort' until a new Training Officer was appointed. It became apparent during this period that there was a need for re-evaluating and restructuring the training modules. The ITC was in the process of implementing Competency Based Modular Training (CBMT) for apprentices and the time was ripe for change. During 1996 and 1997, the Sugar Manufacture and Laboratory Worker courses were extensively revised and rewritten. The following are features of the new courses:

- Detailed, illustrated reference manuals have been created for each course
- Greater emphasis has been placed on the underlying theoretical aspects and principles of the manufacturing process
- Relevant calculations are emphasised where appropriate
- Examinations are structured to test both factual knowledge and the candidate's application ability.

The aims of these modules are:

- to give operators and supervisors a good understanding of the technology involved in sugar manufacture and of how the relevant variables interact
- to develop scientific concepts using a logical approach
- to enable the operators to assimilate new information from 'on-the-job' training and absorb it into their existing formal knowledge and understanding.

The net result is that the new ITC courses are much more intense and demanding than in the past and it is inevitable that students completing the ITC courses after 1997 will generally achieve lower results than previously. This, however, is not a reflection of their ability or competence. When considering candidates for promotion, it must be borne in mind that the examinations are so structured that a student who struggles to understand the more theoretical aspects, but who works hard and learns the relevant factual information by rote, will manage a pass mark of 60-70%. Only a capable student who works hard and gains a deeper understanding will achieve a distinction (>80%). The new Sugar Manufacture and Laboratory Worker courses are detailed in Tables 4 and 5.

Table 4. Sugar Manufacture Course syllabus.

Module	Duration	Topic
1	4 weeks	Basic Concepts: mathematics, physics and chemistry
2	3 weeks	Quality Control: measurement of pol and brix and stocktaking
3	2 weeks	Juice Extraction
4	1 week	Clarification
5	1 week	Evaporation
6	2 weeks	Pan Boiling
7	1 week	Crystallisation and Centrifugation
8	1 week	Factory Services
9	1 week	Sugar Refining

Table 5. Laboratory Practice modules.

Module	Duration	Topics
1	4 weeks	Identification and use of laboratory apparatus, basic analytical techniques, calculations and graphs
2	5 weeks	Sugar analysis, theory and practice.
3	3 weeks	Factory calculations, stock taking etc.

The future

The role of the laboratory in a factory is important because the analytical data are used to manage the process and must, therefore, be accurate and credible. This emphasises the need for continual auditing of factory laboratories by the SMRI. In order to maintain competence, there is a need for refresher courses to be run at factories in order to raise and maintain the standards of the analytical procedures (*cf.* first aid certificates which are valid only for three years). This has become apparent during laboratory audits conducted by the SMRI, and is particularly important where staff have been trained using the old ITC modules. It is important to note, however, that these 'refresher' courses would not be intended to replace the ITC Laboratory Worker courses, but to supplement them.

With regard to the Sugar Manufacture training, the ITC is investigating the feasibility of offering correspondence courses in this subject. Distance training, however, places much greater demands on the learner and can usually only be applied successfully under special circumstances. For example, the student must have very good literacy and numeracy skills, and a knowledgeable staff member at the factory will need to act as a mentor to deal with questions and queries from him/her. This route is seen as a possible cost effective option for foreign students and for local students needing to repeat a module.

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